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MEASURING THE PERFORMANCE OF ECOMMERCE WEBSITES

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Abstract

Measurements that capture website performance have long enabled businesses to improve strategies and operations. For an eCommerce website, there exists a limited understanding on how performance is measured. Measuring the performance of a website has been proposed in many ways and various contexts over the past decade. The study presented in this article used the owner perspective to theoretically develop and empirically test measurement model of website performance. The results suggest that performance is a second order factor model. The first order factors of the model are termed usage, financial returns and owner satisfaction. The resulting measurements are framed as a tool for benchmarking the performance of the website as well as a foundation for operationalising the website performance construct.

Keywords: Website, Website Performance, eCommerce, Structural Equation Modelling.

1 INTRODUCTION

Many businesses have responded to the media hype surrounding the growth of eCommerce and invested in this growing market. A website as a subsequent action is then built as a first step. Successfully integrating websites into the fabric of their business and their sales strategies is critical for the survival of businesses that sell products/services online. Effective web-based selling requires businesses to have adequate knowledge of how to measure the performance of their website as part of their management practices. Clear, useful measurements that capture website performance have long enabled businesses to improve strategies and operations as part of their evaluation effort (Straub et al. 2002). Given the website is a sales channel (sometimes a company's sole interface) between the business and customers and the world at large, plus the growing demands to see returns on internet-related investments, a stronger focus on performance is becoming critical for internet-based eCommerce (Auger 2005). In addition, the proliferation of websites, and the many calls from businesses for their use, has prompted researchers to investigate the effectiveness of such initiatives. However, this would not be possible without an appropriate tool for measuring the performance of their websites.

Measuring the performance of a website has been proposed in many ways and various contexts over the past decade. In many instances, a single or a collection of items were used to represent website performance. However, website performance is neither simple nor straight forward. Website performance is a complex concept; therefore its measurement is expected to be multidimensional in nature. The different perspectives are only adding another layer of complexity to the construct measurements. While the user and the designer perspectives are well advanced in the literature, there are sparse studies that address the owners' needs. Today, no multi-item scale is available to measure the performance of a website based on the owner's experience. The provision of such a scale will further enhance owner's ability to realise benefits.

This article reflects upon the owner perspective to develop a performance measure that can be used to understand what constitutes an effective website. The remainder of this article is organised in three sections. The background of the study is introduced in the Section 2, where the theoretical perspectives for measuring performance and the literature for the owner perspective are examined. The Section 3 introduces the research design. The concluding section discusses the results and describes the implications of the study.

2 BACKGROUND

The importance of web performance metrics has been established in the literature (Bremser and Chung 2005; Hahn and Kauffman 2001; Huizingh 2002; Jonathan 2002; Wade and Nevo 2005; Welling and White 2006). eCommerce is one of the fields that implement such metrics but often there are controversies over the metrics to be used. Past studies indicate that issues pertaining to website management are of a great importance to managers all over the world (Adam and Deans 2001; Ho 1997; Kim et al. 2003). Different metrics have been proposed in many ways and various contexts over the past decade. In general however, practising managers still have no structured set of criteria upon which to gauge the performance of their eCommerce websites. In many instances, simplistic and rather varied measures in capturing aspect of performance are utilised (DeLone and McLean 2004; Molla and Licker 2001). This inconsistency has hampered conclusions regarding the effectiveness of websites and practices associated with their management.

The measurement of website performance has proven to be a difficult task as it depends on which stakeholder perspective (the user, the designer or the business) is assumed. It is also difficult because it is a multidimensional concept (Palmer 2002) that can be assessed at different levels (individual, organisational) using different interrelated criteria (Molla and Licker 2001). Multiple, interrelated success dimensions are more likely to capture changes in performance than one single item or even a set of financial measures (Segars and Grover 1998). Financial measures only portray one facet of performance (Auger 2005; Barua et al. 2001; Barua et al. 1995; Quaddus and Achjari 2005).

An examination of literature within information systems (IS) and website evaluation reveals three perspectives when assessing the effectiveness of a website, user, designer, and owner.

The literature has reported that the user perception of a website can strongly affect its performance and that the user is affected by the positive experience with the interface. These studies address the topic of website quality and user satisfaction with the website as measures of performance. Several instruments have been developed to define, measure, and manage the quality of websites (Aladwani and Palvia 2002; Barnes and Vidgen 2003; Katerattanakul and Siau 1999; Loiacono et al. 2002; Mich et al. 2003; Sharkey et al. 2007; Webb and Webb 2004; Zhang and Von Dran 2002). Similarly, instruments have been developed to define and measure user satisfaction with the website (Bailey and Pearson 1983; Baroudi and Orlikowski 1988; Bharati and Chaudhury 2004; Doll and Torkzadeh 1988; McKinney et al. 2002; Muylle et al. 2004; Wang et al. 2001; Zviran et al. 2006). The underlying premise of these studies is that the performance of the websites is measured by how satisfied the users are with the website and consequently how willing they would be to revisit the site. The more frequently visitors visit a website, the greater the possibility they will make a purchase. For example, maintaining a high quality website affects the number of people visiting the website and subsequently doing business with it (Udo and Marquis 2001). These studies have also served to improve website designs in terms of “what to include” but have done little to inform businesses on success or profitability.

The designer perspective reveals features that are imperative for websites (Auger 2005; Day 1997; Drèze and Zufryden 1997; Kim et al. 2003; Kohavi and Parekh 2003; Mich et al. 2003; Olsina et al. 2000; Palmer 2002; Spiliopoulou 2000; Turban and Gehrke 2000; Udo and Marquis 2001; Zhang et al. 1999). The information gained from these studies is important to designers who face the task of planning future website designs.

Another important perspective is that of the owners. The owner perception of a website can strongly affect its performance and that the owner is affected by the website usage and its financial gains (Alpar 2001; Huizingh 2002; Quaddus and Achjari 2005). The recent literature reports that the website performance can be measured in terms of its clickstream data which can be available to owners.

Although each of these perspectives is a legitimate approach for assessing website performance, each has its own insights. While insights of understanding user behaviours and designers’ attitudes in the web are important to understand areas for improvement and enhance the website accordingly, it is, however, critical to identify website effectiveness from the business (owner) perspective. The owners’ perceptions can at least help to pinpoint areas within the business where eCommerce is creating value; they are the ones who need to know the payoff for their IT investment (Tallon and Kraemer 2002).

There have been a number of attempts to include the owner perspective (Huizingh 2002; Huizingh et al. 2007; Lu 2003; Quaddus and Achjari 2005; Stockdale et al. 2006; Teo and Pian 2004; Zhu and Kraemer 2003). These are either incomplete (Lu (2003) for example, included only one item, company satisfaction, to measure website performance) or used the already established user perspective tools to evaluate websites. Stockdale et al. (2006), guided by the instrument eQual, developed by Barnes and Vigden (2002), tried to identify critical success factors for effective website usage by small businesses from the owner’s perspective. While eQual was developed for a “user voice” perspective, nevertheless owners were found to be able to see where they would like to progress in the future. The literature also shows some examples of how companies develop metrics for eCommerce and the effectiveness of their websites (Straub et al. 2002). A well developed measure for an eCommerce website based on the owner experience is still unavailable in the literature. Such measures would enable owners to realise the benefits in order to progress or reinvest.

Although sparse, studies that have taken a partial owner perspective, have used performance measures of website usage by analysing click stream data (Alpar 2001; Quaddus and Achjari 2005), financial returns measures (Zhu 2004; Auger 2005), or owner satisfaction (Huizingh 2002). While each of these studies has recognised the multidimensionality to capture the change in website performance, neither have combined these dimensions into one framework. This would have provided additional insights into the performance of the website.

Utilising the owner perspective, an extensive review of IS literature was conducted to identify the different measures used to assess the performance of a website (Table 1). Three broad dimensions were identified. These dimensions are termed usage, financial returns, and owner satisfaction. The content domain of each of the three dimensions and relevant literature is summarised.

AUTHORS	Performance construct	Concept used		
		Website Use (Metrics)	Financial Returns	Owner Satisfaction
Thelwall, 2000			X	
Barua <i>et al</i> 2001	Operational Excellence	X		
Barua <i>et al</i> 2001	Financial performance		X	
Udo and Marquis 2001	Website Effectiveness	X		
Molla and Licker 2002	eCommerce System Use	X		
Olson and Boyer 2003	Organisational performance		X	
Lu 2003	EC success			X
(Zhu and Kraemer 2003)	Firm Performance		X	
(Lii <i>et al</i> 2004)	Website Effectiveness			
DeLone MacLean 2004	Net Benefits	X	X	
Scharl <i>et al</i> 2004	Website Effectiveness	X		
Quddas and Achjari 2005	eCommerce Success	X		
Auger, 2005	Overall performance	X	X	
Pujani and Xu 2006	Organisational benefits	X	X	
Schaupp <i>et al</i> (2006)	Website Effectiveness			
Huizingh <i>et al</i> 2007	Website Success			X
Fisher, 2007	Website Success	X		
Hong 2007	Website Success	X	X	

Table 1: Concept Map adapted from Webster and Watson (2002 p xvii)

2.1 Website Usage

A traditional method of measuring website usage is by conducting market research and asking users of their experience. Such an approach is often costly and time consuming (Spiliopoulou and Pohle 2001; Weischedel and Huizingh 2006). Alternatively, data can be automatically collected about visits to the site which allow owners to aggregate data and possibly evaluate their website effectiveness (Schonberg et al. 2000; Spiliopoulou and Pohle 2001). Online technology is able to collect large amounts of detailed data on visitor traffic and activities on websites. Such data offer a plethora of metrics to which businesses must carefully choose measures for different purposes (Phippen et al. 2004). Otherwise, the sheer amount of data available can be overwhelming, as can the multitude of ways to compare it.

For the purpose of this research, website usage is captured by the different metrics available to owners who utilise clickstream data which reflects how users are using the website. These metrics are critical to assess website activities and user behaviour. From the owners perspective, such metrics may suggest where improvements can be made with regard to design, layout, and navigation issues (Schonberg et al. 2000). Despite the limitations of clickstream data (Weischedel and Huizingh 2006), detailed and concrete data on users' behaviour can be collected to indicate trends rather than provide definitive data/statistics on website usage. Indeed, a reasonable measure could be determined by assessing whether the full functionality of a website is being used for its intended purposes (Welling and White 2006).

Currently, there are tools that provide various statistics about website usage (for example, Google analytics, LiveSTATS.XSP, and CMS400.NET). Such tools only provide raw metrics of little benefit to businesses using them (Hong 2007; Phippen et al. 2004; Spiliopoulou 2000). In addition, even though web metrics may be capable of extracting interesting website usage patterns and could indicate how users are actually using the website, the link to business performance is still lacking (Hahn and Kauffman 2001). Websites' owners need to convert these raw metrics into meaningful information that can be used in evaluating the commercial performance of eCommerce websites.

2.2 Financial returns

For online transaction websites, the financial returns are of special interest. Giaglis et al (1999) observed that the most common methods of evaluating information technology investments is by way of established accounting techniques, such as Return on Investment (ROI). According to Zhu (2004), the business value of eCommerce is best measured by gains in financial performance. However, firms are reluctant to divulge objective measures of performance, in particular the financial returns of their eCommerce websites, for competitive reasons (Epstein 2004). Instead managers are likely to communicate their evaluation with the performance of their websites subjectively. The complexity of trying to tease out these performance figures from managers needs rigorous scientific methods that are often missing in prior work. Managers' perceptions of the accrued benefits are reflected according to their eCommerce website meeting its objectives. Many different studies have shown that subjective measures of performance (managers' perceptions of performance) are closely correlated with various objective measures of financial returns (Dess and Robinson 1984; Venkatraman and Ramanujam 1987).

2.3 Owner Satisfaction

Recent literature reports that owners determine their IT expenditure according to their satisfaction with the website (Huizingh 2002). When the website drives traffic, communicates certain features that enhance the users' experience, generates trust and strengthens the competitive position of the business, the owners are inclined to be satisfied. The extent to which this has been realised is either in monetary terms (sales increased or cost reduction) or in the form of intangible benefits (such as strengthening competitive position) (Huizingh 2002). The main reason businesses establish a presence on the web is to capture these tangible and intangible benefits (Kim et al 2003).

3 RESEARCH DESIGN AND METHOD

3.1 Developing the Website Performance Instrument

Given the focus of this study is to develop a website performance measuring instrument based on the owner perspective and the multidimensionality of such a concept, the three factors discussed (usage, financial, and satisfaction) represent an a priori model of the theoretical construct space of website performance. While each factor measures one aspect (dimension), the system of factors measures a second order factor of website performance. Working within this context, an instrument was developed guided by a three stage process suggested by Churchill (1979) and DeVellis (2003). The three stages are: instrument development, instrument refinement and instrument confirmation.

In the development stage, the factors were specified and initial items for each factor developed through an extensive literature review. Three factors of this study are defined (website usage, website financial benefits, and owner satisfaction). Items from available resources of similar factors in published studies were collated to generate a large pool of items.

In the refinement stage, a panel of academics and a panel of business owners reviewed the selected items for contents, wording, clarity, format, ease of use, and appropriateness. The feedback led to some changes, some items were slightly refined and in other instances an item is added. A preliminary assessment indicated that there was a high degree of internal consistency among scale items. *In the third stage*, the instrument was subjected to a comprehensive test of reliability and validity.

3.2 Data Collection and analysis strategy

An online survey was chosen because. The population for this study was online businesses within New Zealand. A survey sent out by email to businesses engaged in eCommerce. A total of 1093 emails were sent out, and 344 responded giving a 31.47 % response rate. This was considered to be appropriate for the growing field of eCommerce (Couper 2000; Sheehan and McMillan 1999). However, there were only 225 (20%) businesses that are actively engaged in web analytics.

In order to empirically test the proposed priori, a two-step approach of Structural Equation Modeling (SEM) is utilised. It provides an appropriate means of assessing the efficacy of measurement among scale items and the consistency of a prescribed structural equation model with its associated network of theoretical concepts. According to Boomsma (2000), measurements of latent variables are part of the theory. The separation between measurement and structural models, however, is to allow for the inspection of measurement problems from the inspection of theory problems (Gerbing and Anderson 1988). Working within this context, each of the measured factors is modelled in isolation and then as a collective network. AMOS 17 was utilised as the analytical tool for testing statistical assumptions and estimation of the measurement and structural equation models. the following fit indices CFA, GFA, and RMSEA with the values $> .9$, > 0.9 (Byrne 2001), and < 0.08 (Newcomb 1994) respectively and The CMIN/DF, are the chosen fit indices that determine the model fit in this study.

4 RESULTS

4.1 Measurement models

To examine an acceptable fit of the proposed measurement models, each of the factors was evaluated by examining the statistical significance of each estimated loading, and the overall model fit indices were evaluated. All indicators with loading below the cutoff value of 0.5 were deleted (Hair et al. 1998). The goodness-of-fit indices for each factor are shown in Table 2.

4.2 Reliability and Validity

Beyond examination of the loadings for each indicator (unidimensionality and convergent validity), the measurement model is further assessed for reliability and validity.

The composite reliability for each construct (CCR) of this are: 0.81 for usage, 0.85 for financial returns and 0.86 for satisfaction. The composite reliability of all latent constructs exceeded the benchmark of 0.7 recommended by [Hair et al \(1998\)](#). All Average Variance extracted (AVE) were above 0.5, indicating convergent validity of all factors.

In addition, the analysis results showed that the squared correlations for each factor is less than the variance extracted by the indicators measuring that factor, as shown in Table 3, indicating the measure has adequate discriminant validity. In summary, the measurement model demonstrated adequate reliability, convergent validity and discriminant validity.

Latent Variable	#Items	CMIN/DF	RMSEA	TLI	CFI	GFI
USE	9	1.67	0.05	0.96	0.97	0.96
Financial	5	1.84	0.06	0.99	0.99	0.98
Satisfaction	4	0.26	0.01	0.99	0.99	0.99

Table 2: Goodness-of-fit statistic for measurement models

	Usage	Financial	Satisfaction
Usage	0.53		
Financial	0.572* (0.327)	0.66	
Satisfaction	0.530** (0.281)	0.653** (0.426)	0.67

**. Correlation is significant at the 0.01 level (2-tailed).

Diagonals are the value of average variance extracted (AVE).

Off-diagonals are the constructs correlations (squared)

Table 3 Discriminant Validity

4.3 CFA Model

While the measurement models define the relationships between the observed and the unobserved variables, CFA specifies the pattern by which each measure loads on a particular factor given more than one latent factor which is then tested for validity using CFA procedures ([Byrne 2001](#)). Three factors (Usage, Financials and Satisfaction) were tested as a collective network. The results show that these three factors are distinct. In other words, these dimensions are independent in their prediction of website success. Seven indicators represent the usage of the website; four indicators represent the financial returns and four factors represent satisfaction.

4.4 The Structural Model

While the measurement model allows the inspection of how well the scale measures the concept under investigation, the structural model inspects the relationships between concepts (factors). As theorised, the website performance is evidenced across multiple dimensions. The correlations among the three factors seem to suggest that the website performance is an aggregate of usage, financial returns, and satisfaction. The fit statistics also suggest the existence of such structure. The efficacy of such structure, however, can be tested using SEM (Bollen 1989; Joreskog and Sorbom 1993). As shown in Figure 1 the performance construct is a second-order factor governing the correlations among usage, financial, and satisfaction. The result shows that three distinct dimensions of website explain the change in performance of the website. The fit indices shown in Table 4 indicate relatively good fit. The theoretical interpretation of this higher order factor is an overall trait of the website performance. These statistics indicates good model fit suggesting empirical acceptance of the model. The factor estimates revealed strong significant relationships for website performance acting as a function of website usage (0.79), website financial returns (0.89), and as a function of owner satisfaction (0.85). All standardized estimates were substantively reasonable and statistically significant at $p < 0.05$ level. Overall, the model explained 63% of the variance in “Usage”, 80% of the variance in “Financial Benefit”, and 73% of the variance in “Owner Satisfaction” as reported by the Squared Multiple Correlation (SMC).

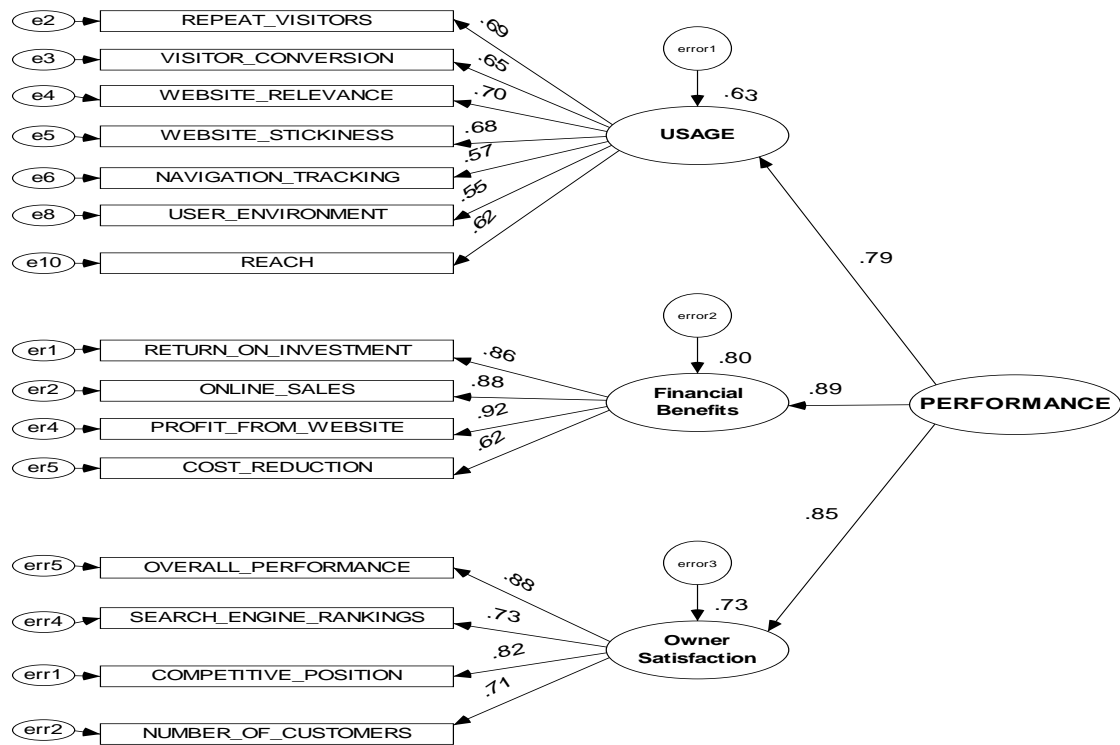


Figure 1: Website Performance Construct

Model	χ^2	df	P	χ^2 / df	RMSEA	TLI	CFI	GFI
Default model	107.77	87	0.07	1.24	0.03	0.99	0.99	0.94

Table 4: Goodness-of-fit statistic for model in Figure 2

5 CONCLUSION AND IMPLICATIONS

The focus of the study was to develop a tool for website performance measurement. In many research contexts, website performance is often captured as a single or small collection of financial measures. The results of this study seem to confirm the contention that performance is multidimensional construct. Given the strong empirical evidence supporting the conceptualisation of performance, it seems that performance underlies more aspects than financial measures. Through successive stages of testing and refinement, this study has arrived at a framework of three factors that can be used to measure websites performance. These factors are:

1. **Usage** (Visitors' information captured by the website measured by web analytics). Six metrics (repeat visitors, relevance, stickiness, navigation tracking, user environment, and reach) are used by businesses to monitor their websites.
2. **Financial benefits** accrued to the business due to the use of its website as realised by the owner. Cost reduction, return on investment, and profit from website represented the financial return of the website.
3. **Owner satisfaction** with the website as an ultimate favourable result. Competitive advantage, number of customers, search engine rankings, and overall performance represented owner satisfaction.

The findings showed that these three factors explain the overall performance of the website. More importantly, the results showed that these three factors are serially related. The change of performance in a website is attributed to any of these three dimensions. In other word the performance of a website can be gauged by administering the 14 items of the three factors.

Therefore, it becomes appropriate to frame studies within the multiple dimensions of performance as defined in this study. In the absence of such measures the broader view of performance must not be captured leading to faulty conclusions.

The contribution of the study is that while past website performance research focuses mostly on the perspective of users and designers, this study targets the website owners.

To date, there was no performance measure to assess websites in the eCommerce environment. In this study, fourteen variables in the three performance factors exhibited validity and reliability. While owners may find these variables useful to evaluate their website, academics interested in performing research relative to the evaluation or success of websites can use these variables as the basis for the their research.

This study is not without its limitations, one is concerned with the nature of the sample utilised in this analysis. The data for this research came from 245 businesses of size less than 100 persons. The sample is representative for the whole population of online businesses in New Zealand as 97% of New Zealand businesses are small ([Ministry of Economic Development 2009](#)). Therefore, generalising the findings beyond small businesses may be problematic. Limitations attributable to sample size may not be problematic due to meeting requirements for the analysis method used.

A subsequent strength of this study lies in its foundation for future research. Further inquiry concerns combining different perspectives in one single framework which could further provide additional insights into the overall evaluation criteria for a website. The three perspectives include users, owners, and designers. The focus of the current study addressed the lack of studies on website success from the owner's perspective.

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